DRAFT

Programmatic Environmental Assessment

for

Fisheries and Ecosystem Research Conducted and Funded by the

Alaska Fisheries Science Center

June 2016

Appendix A

AFSC Research Gear and Vessel Descriptions

Prepared for the National Marine Fisheries Service by:

URS Group

700 G Street, Suite 500

Anchorage, Alaska 99501

Table of Contents

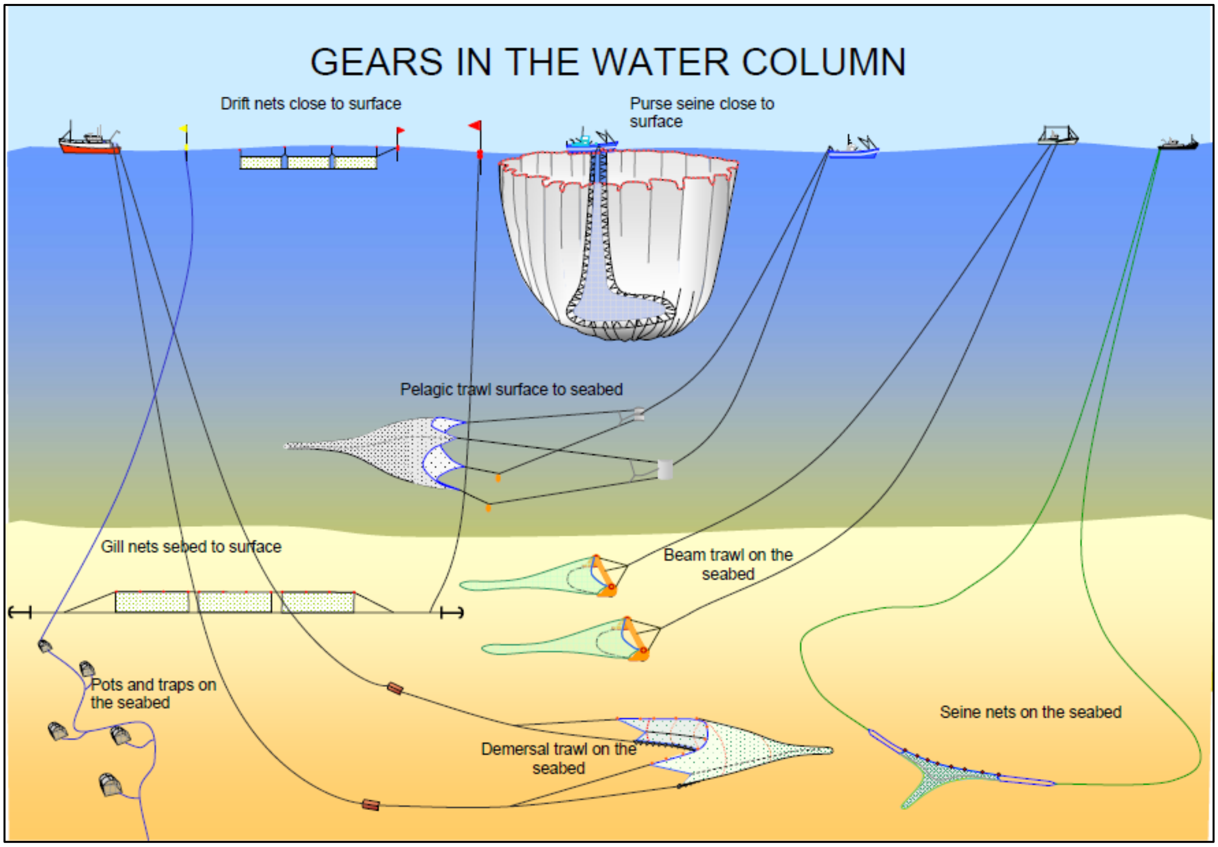
List of Figures

List of Tables

This page intentionally left blank.

1. Net-Based Gear

Various types of sampling gear composed of or containing nets are used by the AFSC in order to catch or trap marine organisms for study. Figure A-1 depicts several types of commercial fishing net gear.



Credit: Seafish 2005. Note: not all depicted gear types are used in AFSC research.

Figure A-1 Fishing gears in the water column

Trawl Nets

A trawl net is a funnel-shaped net towed behind a boat to capture organisms. Trawl nets are made of four basic parts – the opening (or, 'mouth') of the net, the spreading mechanism, the body of the net, and the codend (or, 'bag') (Figure A-2). The mouth is held open vertically using floatation on the upper edge, or 'headrope,' and weights on the lower edge, or 'footrope.' In most trawls used in AFSC research, the mouth is spread open horizontally during fishing using steel trawl doors. In some types of trawl nets, such as beam trawls, the mouth is spread open by a rigid bar called a 'beam'. Large panels of wide mesh at the horizontal reaches of the mouth, called 'wings', are connected to the trawl doors. The mouth of the net is held open (horizontally and vertically) by the hydrodynamic force exerted on the trawl doors attached to the wings of the net, floats placed on the headrope, and the net itself as the vessel moves forward.

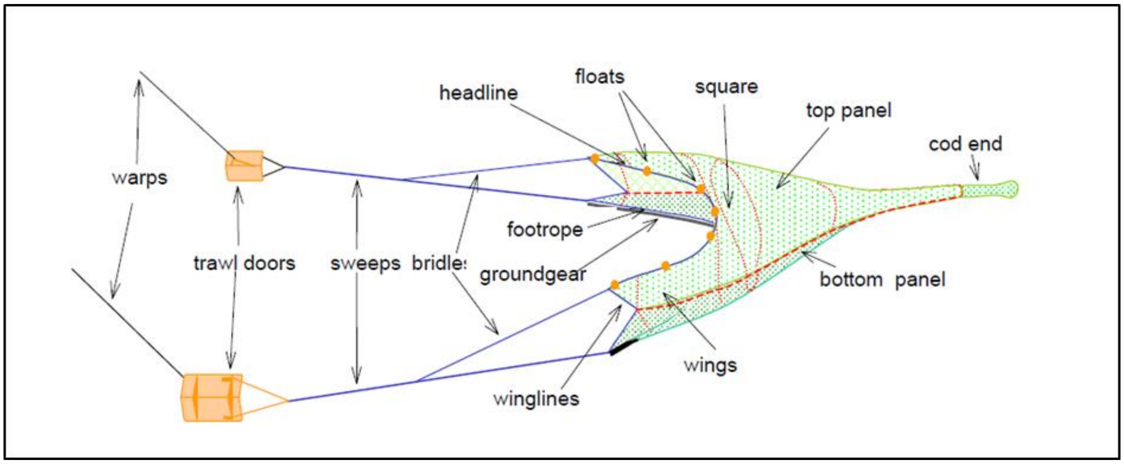
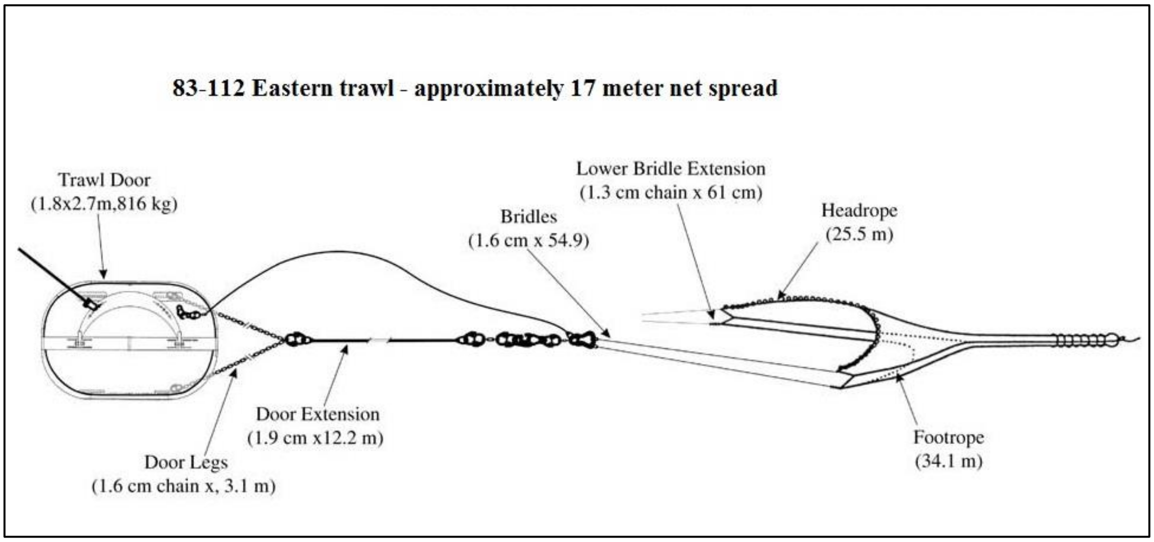


Figure A-2 Otter bottom trawl illustration

The body of the trawl net is made of panels of different sized mesh (Figure A-5). Mesh size is largest at the wings and near the mouth and, depending on construction of the net and target species, mesh size gets progressively smaller towards the codend portion of the net. The codend has the finest mesh of the net and is where fish and other organisms larger than the mesh size are retained. In contrast to commercial fishery operations, which generally use larger mesh to capture marketable fish, research trawls often use smaller mesh throughout the net to catch fish of many sizes. This helps to make estimates of the size and age distributions of fish in a particular area. Research trawls typically have much smaller openings, from 10 to 17 m compared to commercial trawls that can have openings over 90 m.

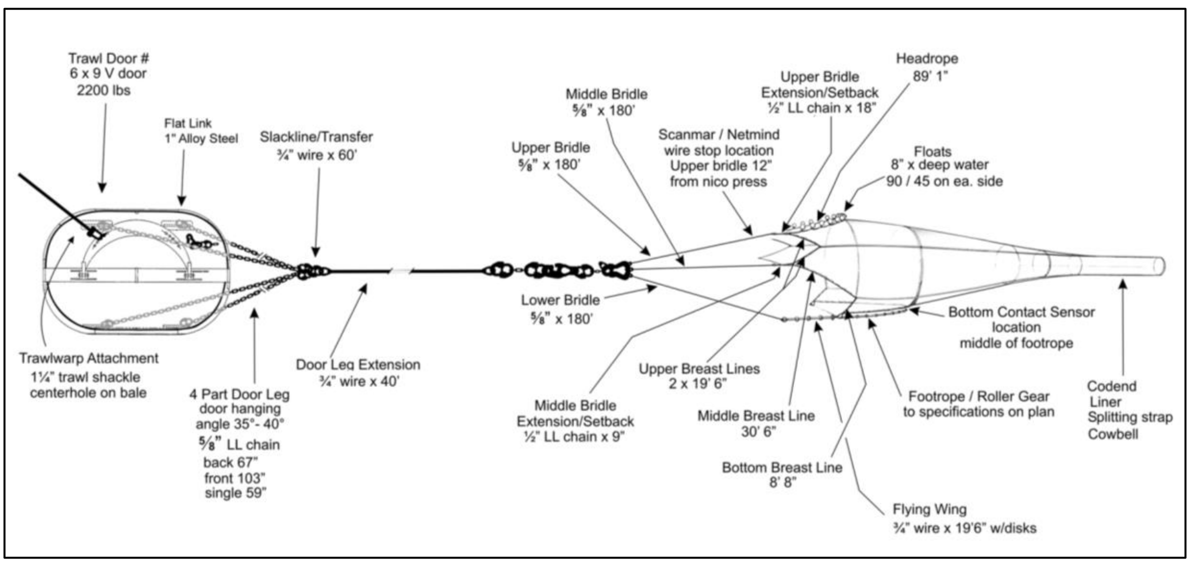
The trawl net is usually deployed over the stern of the vessel, and attached with two cables, or 'warps,' to winches on the deck of the vessel. The cables are paid out until the net reaches the fishing depth. The duration of the tow depends on the purpose of the trawl, the catch rate, and the target species. AFSC trawl surveys typically involve tow speeds from two to four knots and tow durations from 10 to 45 minutes. At the end of the tow, the net is retrieved and the contents of the cod end are emptied onto the deck or sorting table. For research purposes, the speed and duration of the tow and the characteristics of the net must be standardized to allow for meaningful comparisons of data collected at different times and locations. Active acoustic devices incorporated into some research vessels (see below) and trawl gear may be used to monitor the position and status of the net, speed of the tow, and other variables important to the research design.

AFSC research trawling activities use both 'pelagic' (surface or mid-water) trawls, which are designed to operate at various depths within the water column, as well as 'bottom' trawls, which are designed to capture target species at or near the seafloor. Bottom trawls often have bobbins or roller gear to protect the footrope as the net is dragged along the seabed. Within these two basic deployment methodologies, there are many different designs used by the AFSC oriented to the basic needs of each survey or target species. Common bottom trawls include the 83-112 Eastern Trawl (Figure A-3) used in the Bering Sea Bottom Trawl Survey and the more fortified Poly Nor'eastern (PNE) bottom trawl (Figure A-4) used in the Aleutian Islands, Bering Sea Slope, and Gulf of Alaska Bottom Biennial Bottom Trawl Surveys. AFSC also uses push trawls (Figure A-5) during the Yukon Delta Nearshore Surveys. Push trawls differ from most other trawls in that vessels push nets in shallow, nearshore waters.



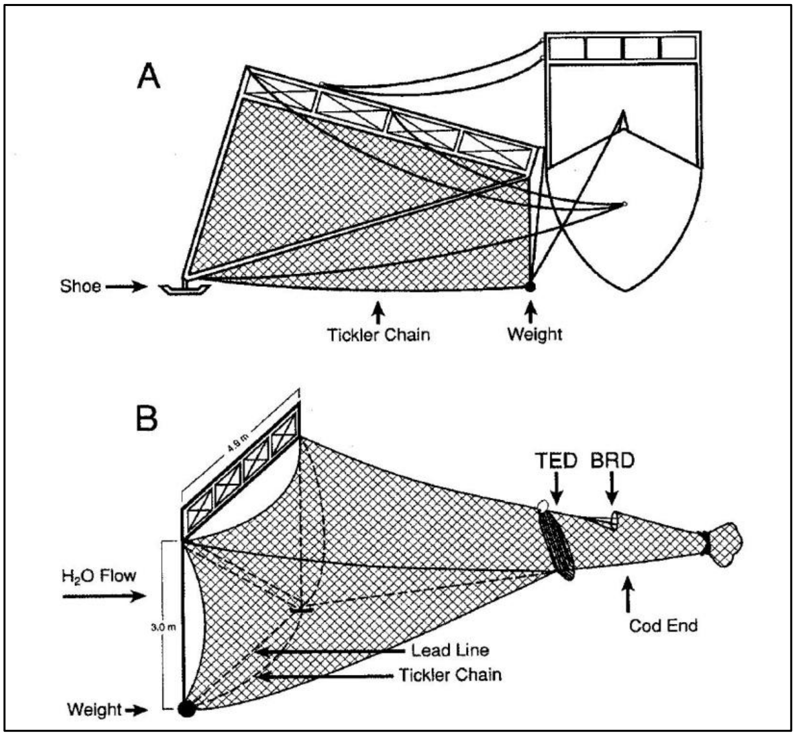
Credit: SFOS 2015

Figure A-3 83-112 Eastern trawl illustration



Credit: Stauffer 2004

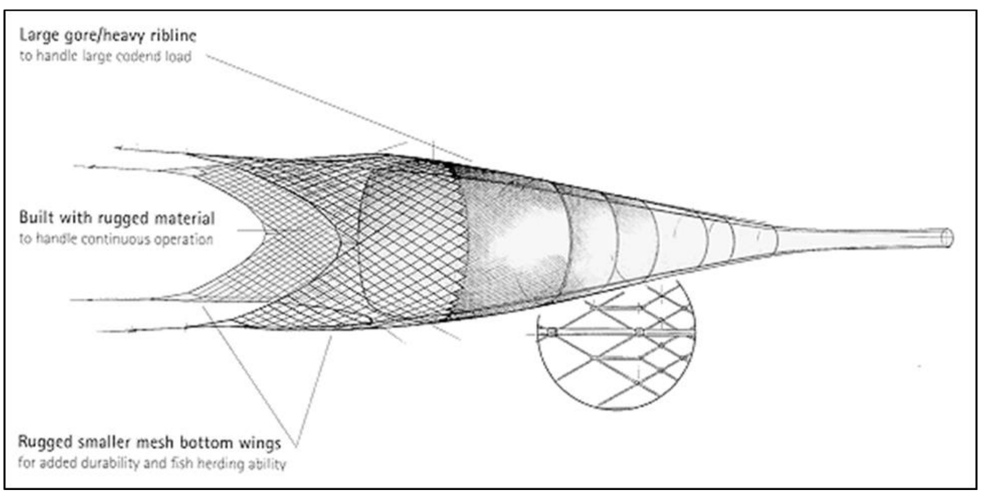
Figure A-4 Poly Nor'eastern bottom trawl illustration



Credit: NOAA 2014; Push trawls used by the AFSC do not include a Turtle Excluder Device (TED) or Bycatch Reduction Device (BRD)

Figure A-5 Push trawl illustration

Midwater trawls include the Nordic 264 trawl, anchovy trawl, Methot trawl, Cantrawl, Marinovich trawl, and Aleutian wing trawl (Figure A-6) used on the Acoustic Trawl Surveys, and the Kodiak trawl (Figure A-7) used in the Yukon Delta Nearshore Surveys. AFSC construction, repair, and use of the bottom trawl survey trawls adhere to national standards (Stauffer 2004).



Credit: Net Systems Inc. 2016

Figure A-6 Aleutian wing pelagic trawl illustration

Credit: California Department of Fish and Wildlife 2015

Figure A-7 Kodiak trawl

A beam trawl (Figure A-8) is a type of bottom trawl that uses a wood or metal beam to hold the net open as it is towed along the sea floor. The beam holds open the mouth of the net and trawl doors are not needed. Beam trawls are generally smaller than other types of bottom trawls. Beam trawls used by the AFSC typically use beams less than or equal to 3 m in length for post-larval, juvenile fish and invertebrate surveys.

Credit: SFOS 2015

Figure A-8 Plumb staff beam trawl

Plankton Nets

AFSC research activities include the use of several plankton sampling nets which employ very fine mesh to sample plankton and fish eggs from various parts of the water column. Plankton sampling nets usually consist of fine mesh attached to a rigid frame. The frame spreads the mouth of the net to cover a known surface area. Many plankton nets have a removable collection container at the codend where the sample is concentrated. When the net is retrieved, the catch is washed to the cod end with a saltwater hose and then the collecting bucket can be detached and easily transported to a laboratory. Plankton nets may be towed through the water horizontally, vertically, or at an oblique angle. Often, plankton nets are equipped with instruments such as flow meters or pitch sensors to provide researchers with additional information about the tow or to ensure plankton nets are deployed consistently. Plankton nets are generally used to collect marine organisms for research purposes, and are not used for commercial harvest. AFSC plankton nets employ mesh sizes from 63 to 500 micrometers (μm).

To capture plankton with vertical tows, the AFSC uses ring nets or CalVET nets. A ring net consists of a circular frame and a cone-shaped net with a collection jar at the codend. The net, attached to a labeled dropline, is lowered into the water while maintaining the net's vertical position. When the desired depth is reached, the net is pulled straight up through the water column to collect the sample (Dougherty 2010).

Bongo nets consist of two cylindrical nets whose frames are yoked together and allows replicate samples to be collected concurrently (Figure A-8). The bongo nets are of various diameters and fine mesh sizes and are towed through the water at various depths to sample plankton in different parts of the water column. During each plankton tow, the bongo net is deployed to the desired depth and is then retrieved at a controlled rate so that the volume of water sampled is uniform across the range of depths. In shallow areas, sampling protocol is adjusted to prevent contact between the bongo nets and the seafloor. A collecting bucket, attached to the codend of the net, is used to contain the plankton sample.

Credit: Morgan Busby, Alaska Fisheries Science Center

Figure A-9 Bongo net

The Tucker net (Figure A-10) is a medium-sized single-warp trawl net used to capture plankton at different depths. The Tucker trawl usually consists of a series of nets that can be opened and closed sequentially without retrieving the net from the fishing depth.

Credit: AFSC 2015a

Figure A-10 Tucker trawl

Neuston nets (Figure A-11) are designed to capture members of the neuston, the collective term for the organisms that inhabit the water's surface. Neuston nets have a rectangular frame and are towed horizontally at the top of the water column, half submerged at 1-2 knots from the side of the vessel on a boom to avoid the ship's wake.

Figure A-11 Neuston net

The Multiple Opening/Closing Net and Environmental Sensing System (MOCNESS) is based on the Tucker trawl principle where a stepping motor is used to sequentially control the opening and closing of the nets using underwater and shipboard electronics (Figure A-12). The electronics system continuously monitors the functioning of the nets, frame angle, horizontal velocity, vertical velocity, volume filtered, and selected environmental parameters, such as salinity and temperature. The AFSC utilizes the MOCNESS and the Multinet to determine the vertical distribution of larval fishes and crabs for use in transport models. Data is also used to investigate the effects of climate variability on recruitment.

Credit: AFSC 2015a

Figure A-12 MOCNESS

Seine Nets

A seine is a fishing net that generally hangs vertically in the water with its bottom edge held down by weights and its top edge buoyed by floats. AFSC uses two types of seines for research - beach seines and pole seines.

Beach seines are deployed from shore to surround all fish in a nearshore area. When setting the net, one end is fastened to the shore while the other end is set out in a wide arc and brought back to the beach. A beach seine can be deployed by hand or with the help of a small boat. When the net is set, each side is pulled in simultaneously, herding the fish toward the beach (Figure A-13). During the entire operation, the headrope with floats stays on the surface and the weighted footrope remains in contact with the bottom to prevent fish from escaping the area enclosed by the net. The beach seines used in AFSC research are 15 to 30 feet in depth and 75 to 150 feet in length, with mesh sizes of less than 1 inch.

A pole seine is a rectangular net that has a pole on either end to keep the net rigid and act as a handle for pulling the net in (Figure A-14). The net is pulled along the bottom by hand as two or more people hold the poles and walk through the water. Fish and other organisms are captured by walking the net towards shore or tilting the poles backwards and lifting the net out of the water.

Credit: Paul Olsen, NOAA Fisheries

Figure A-13 A beach seine being pulled in

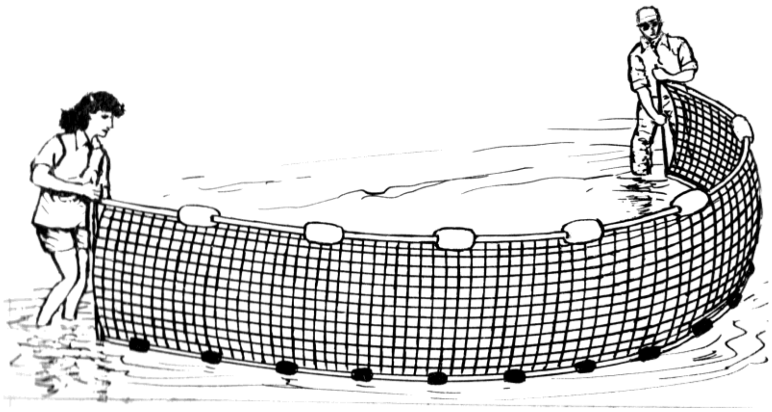


Figure A-14 Pole seine

Cast Nets

Cast nets are a light weight circular net with weights around the perimeter. The net is thrown from shore or from a vessel and falls towards the bottom, trapping any fish that are caught (FAO 2015a). The AFSC uses cast nets to survey forage fish and in educational programs.

Gillnets

Gillnets (Figure A-15) consist of vertical netting held in place by floats and weights to selectively target fish of uniform size depending on the netting size (Walden 1996). Gillnets are either anchored to the bottom ('set gillnet') or are deployed with one end attached to a vessel and is allowed to drift with the current or tides ('drift gillnet'). Gillnets are made of monofilament, multi-monofilament, or multifilament nylon constructed of single, double, or triple netting/paneling of varying mesh sizes, depending on their use and target species (Hovgård and Lassen 2000). A specific mesh size will catch a target species of a limited size range, allowing this gear type to be very selective. The AFSC uses gillnets of various mesh sizes and 35 to 150 ft in length in forage fish and salmon studies.

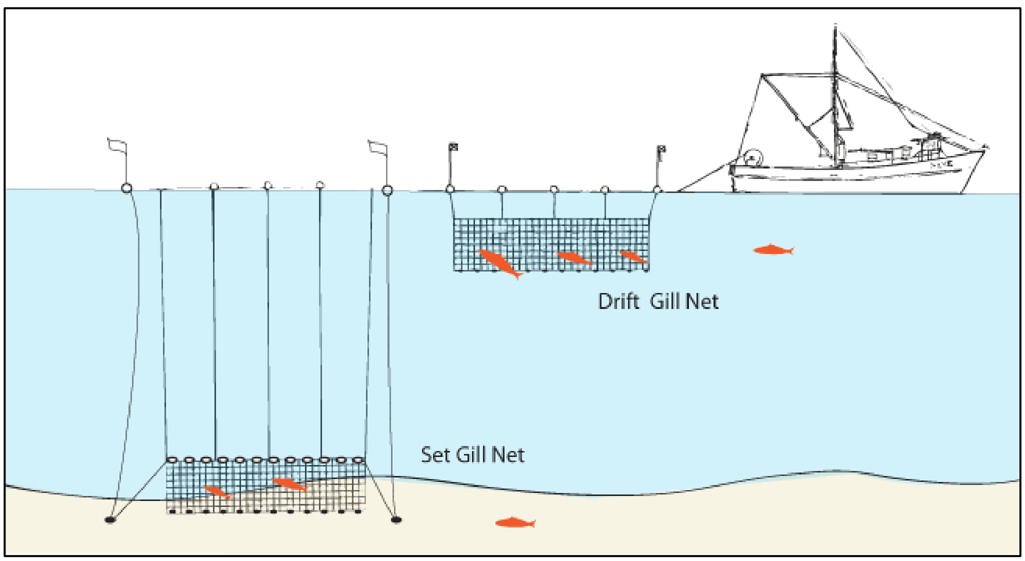


Figure A-15 Diagram of a drift and set gillnet deployment

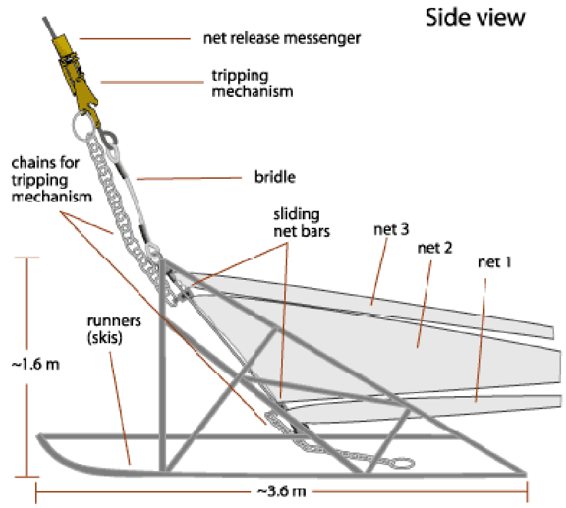
Dip Nets

A dip net (Figure A-16) is a bag net attached to a long rod that is used by hand to scoop fish or other organisms of interest from the water. Dip nets come in various sizes, the AFSC uses dip nets with a diameter range of 0.25m to 0.5m and a mesh size from 505 µm to 6300 µm.

Figure A-16 Dip net

Epibenthic tow sled

An epibenthic tow sled (Figure A-17) is an instrument that is designed to collect organisms that live on or just above bottom sediments. It consists of a fine mesh net attached to a rigid frame with runners to help it move along the substrate (it resembles a Tucker Trawl on skis). The sled is towed along the bottom at the sediment-water interface, scooping up small fish, shrimp, plankton and other organisms as it goes. The AFSC uses an epi-benthic tow sled with a 0.68 m^2 net to collect age-0 flatfish and tanner crabs in nursery areas off Kodiak Island and a 1 m^2 mouth area sled with 0.500 mm mesh in the Arctic to capture near bottom invertebrates and larval fish.



Credit: AFSC 2015a

Figure A-17 Diagram of an epibenthic tow sled

Rock Dredges

The AFSC uses a six foot wide Virginia crab style dredge fitted with a half inch nylon mesh liner (Figure A-18). This dredge type consists of a heavy metal rectangular form bearing a toothed drag bar and a mesh bag to collect specimens.

Credit: Maryland Department of Natural Resources 2016

Figure A-18 Virginia crab style dredge

Pots and Traps

Fishing pots and traps are three-dimensional structures that permit fish and other organisms to enter the enclosure but make it difficult for them to escape. Traps and pots allow commercial fishers and researchers to capture live fish and can allow them to return bycatch to the water unharmed. Traps and pots also allow some control over species and sizes of fish that are caught. The trap entrance can be regulated to control the maximum size of fish that enter. The size of the mesh in the body of the trap can regulate the minimum size that is retained. In general, the fish species caught depend on the type and characteristics of the pot or trap used. Fishing traps and pots used by AFSC include fyke nets, net pens, weirs, and pots.

A fyke net (Figure A-19) is a fish trap that consists of cylindrical or cone-shaped netting bags that are mounted on rings or other rigid structures and fixed on the bottom by anchors, ballast or stakes. Fyke traps are often outfitted with wings and/or leaders to guide fish towards the entrance of the bags. The Fyke net used by the AFSC is constructed with a length of 40 ft and a mesh size of ½ inch and is only deployed in freshwater to capture juvenile salmon.

Figure A-19 Fyke net diagram

A net pen is a three sided net with no top that is designed to hold fish alive. The net pen used by AFSC is 20 ft deep by 20 ft wide by 20 ft long.

A hoop net is a long conical trap made of multiple successive hoops, typically six or seven, and multiple nested funnels. Fish swim into each successive funnel and become trapped (FAO 2015b). The hoop net used by the AFSC is 3 ft in diameter and 8 ft in length with a mesh size of ¼ inch.

A weir is a barrier across a river that is designed to alter the movements of fish so they can be either caught more easily or counted. There are many types of designs and constructions of weirs, from temporary wood weirs to permanent concrete and metal weirs. The type of weir utilized for a particular area is dependent on the tides, bathymetry, and species being targeted. The AFSC operates the Auke Creek Weir in the Juneau area of Alaska. This weir is used for tracking salmonid migration patterns in Auke Creek.

Pots generally consist of a rigid square, circular or conical frame made of steel, wood, or plastic. Stretched between the framing members is nylon netting with one or more funnel-shaped entrance tunnels. Pots are often baited with squid and herring and thrown overboard to rest on the seafloor and are often attached by a rope to a buoy at the water's surface. If a series of pots is set, a groundline may be used to connect the pots to each other to aid in pot deployment and retrieval. Groundlines and vertical buoy lines can pose an entanglement hazard for marine mammals (NOAA Fisheries 2014). Various pot designs set in a longline fashion are used by the AFSC for the Octopus Gear Trial and Maturity Study in order to determine a configuration that is most effective at collecting octopus and other organisms for biological collection.

2. Hook-and-Line Gear

Numerous variations of fishing gear use hooks in order to catch marine organisms. Two types used by the AFSC for research are bottom longline gear and rod-and-reel gear.

Bottom Longline

Longline fishing is a technique for catching fish in which baited hooks attached to a mainline or 'groundline' are deployed from a vessel. The hooks are attached to the longline by thinner lines called 'gangions.' Longlines can be deployed on the bottom ('bottom longline', Figure A-20), or suspended in midwater ('pelagic longline'). Bottom longlines have a weighted groundline anchored on the seafloor with long buoy lines at either end to allow it to rest on the seafloor while the attached buoys float on the surface. Each end buoy has an attached mast with radar reflector and lights which help crew find the line for retrieval.

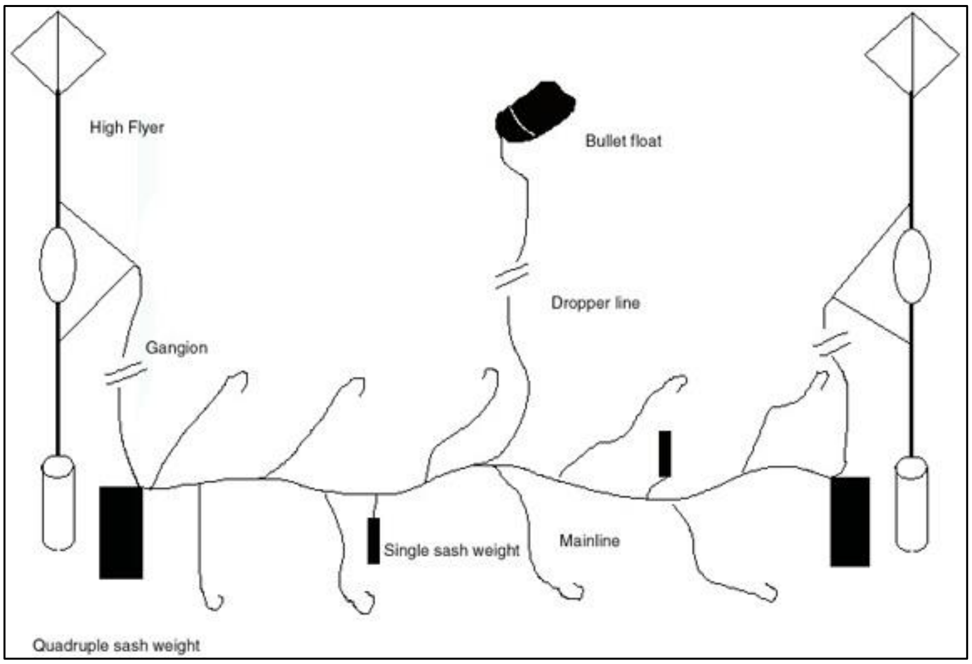
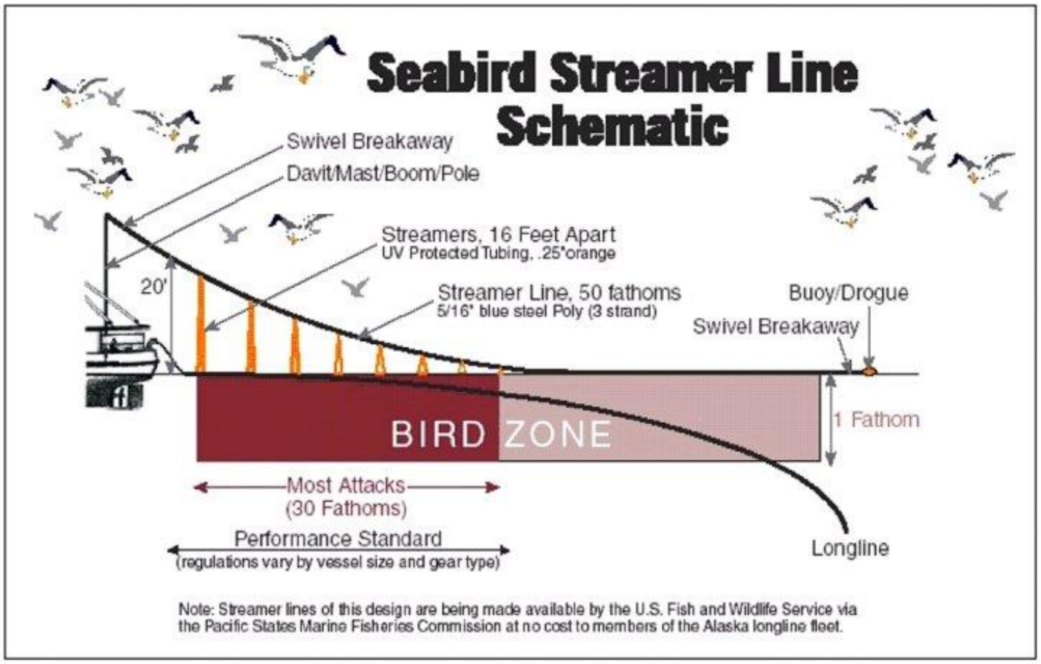


Figure A-20 General bottom longline diagram

The depth and length of the longline, the number of hooks, the length of the gangions, the duration of the set, and the distance between each gangion depend on the species targeted, the size of the vessel used, and the purpose of the fishing activity. A commercial longline set can be well over 10 miles long, have up to 20,000 baited hooks and once deployed can soak anywhere from hours to days ('soak time'). Longlines used for AFSC research purposes are 16 km in length, have 7,200 hooks, and soak for three hours, although haulback operations can take up to eight hours to complete.

Soak time is an important parameter for calculating fishing effort. For commercial fisheries, the optimal soak time maximizes the catch of target species while minimizing bycatch and minimizing damage to hooked target fish that may result from sharks or other predators. Haulback operations and soak time can be an important factor for controlling longline interactions with protected species. Marine mammals may be attracted to bait during haulback, or to fish caught on the longline hooks, and may become caught on longline hooks or entangled in the longline while attempting to feed on the catch before the longline is retrieved.

Birds may be attracted to the baited longline hooks, particularly while the longline gear is being deployed from the vessel. Birds may get caught on the hooks, or entangled in the gangions while trying to feed on the bait. Birds may also interact with longline gear as the gear is retrieved. Tori lines, consisting of paired streamers, are deployed prior to every longline set to mitigate entanglement of seabirds diving on baited hooks. The tori line gear and deployment protocols are consistent with the bird-avoidance requirements imposed on the commercial longline fleet under Magnuson-Stevens Act regulations in Alaska (Figure A-21).



Credit: Washington Sea Grant, Seattle WA

Figure A-21 Tori lines deployed for longline sets to deter seabirds

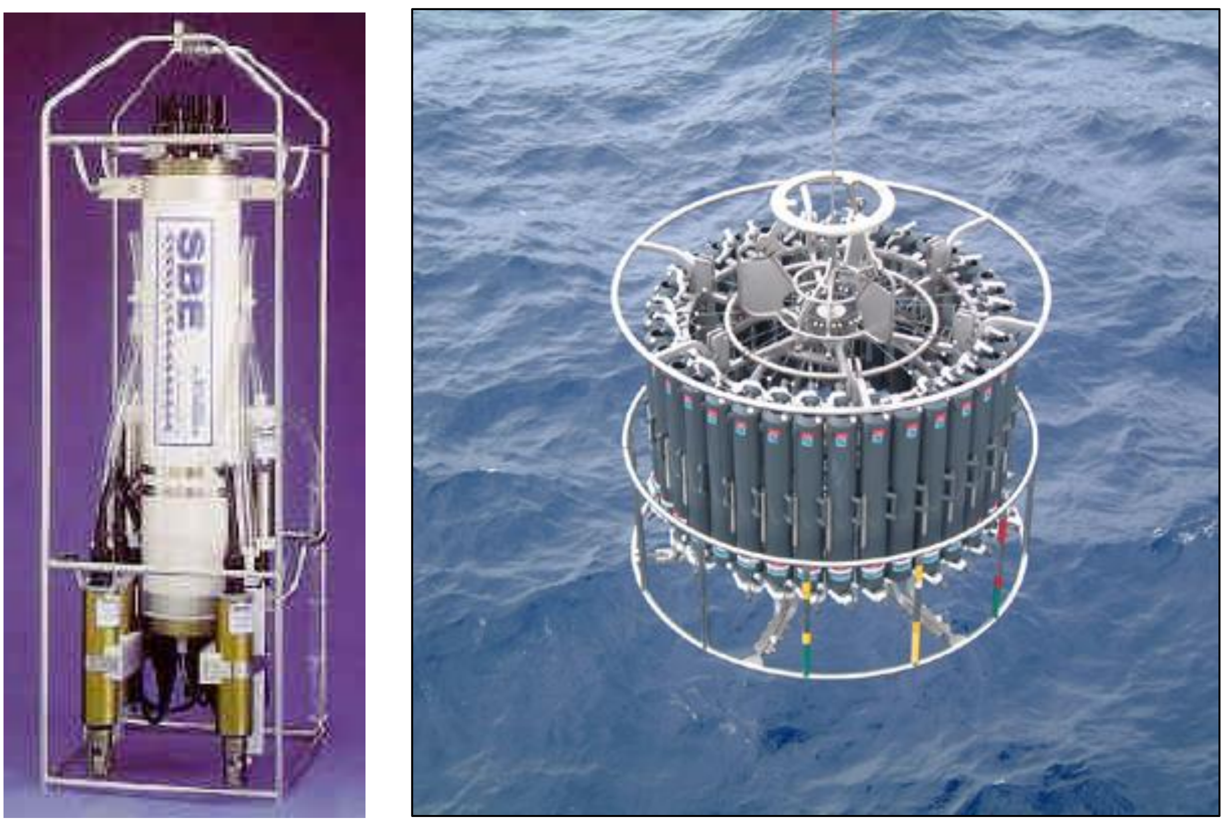
Rod and Reel

A standard fishing pole with a reel attached near the base can be used to catch fish in areas where longline, trawl or other gears are not feasible, such as complex bottom substrates, or where the survivability of the fish after capture is important. The AFSC utilizes rod and reel gear for their Juvenile Sablefish Tagging Survey. In this survey, baited jigging rigs are used in order to catch sablefish for mark and recapture analysis.

3. Oceanographic Instruments

Conductivity, Temperature, and Depth (CTD) and Water Samples

A CTD profiler measures these parameters and is the primary research tool for determining chemical and physical properties of seawater. A CTD profiler may be a fairly small device (Figure A-8 immediately above the Bongo net) or it may be deployed with a variety of other oceanographic sensors and water sampling devices (e.g., Niskin or go-flo bottles) in a large (1 to 2 meter diameter) metal rosette wheel (Figure A-22). The CTD profiler is lowered through the water column on a cable, and CTD data are collected either within the device or via a cable connecting to the ship. Water sampling devices range from a bucket dropped over the side of a small boat to Niskin bottles that are triggered at discrete depths to collect a suite of water samples throughout the water column. A CTD cast takes from minutes to hours to complete depending on water depth (WHOI 2011). The data from a suite of samples collected at different depths are often called a depth profile, and are plotted with the value of the variable of interest on the x-axis and the water depth on the y-axis. Depth profiles for different variables can be compared in order to glean information about physical, chemical, and biological processes occurring in the water column.



Credit: Sea-Bird Electronics, Bellevue WA

Figure A-22 Sea-Bird 911 and CTD deployment on a sampling rosette with Niskin bottles

Free Fall Cone Penetrometer

The Free Fall Cone Penetrometer (FFCPT) is a 52 kg probe designed to free fall through the water and penetrate 3 meters into the seabed (Figure A-23). Sound velocity is measured during deployment, and deceleration and pore pressure are measured at the end of free fall, allowing a profile of sediment types to be inferred. The FFCPT can be deployed at vessel speeds of up to 6 knots, allowing sediment sampling and sound velocity data to be collected without stopping the vessel.

Figure A-23 Free Fall Cone Penetrometer

4. Submersible Delta

The Delta (Figure A-24) is a battery powered two-person submersible with sonar, data loggers, manipulating arms, and other equipment for oceanographic and biological sample collection. The Delta is 15 1/2 feet long, weighs 4,800 lbs, and can dive to a maximum depth of 1,200 feet with a maximum speed of 1.5 knots (Delta Oceanographics 2015).

Credit: AFSC 2015b

Figure A-24 Delta submersible photo

5. Active Acoustic Sources

A wide range of active acoustic sources are used in AFSC fisheries and ecosystem research for remotely sensing bathymetric, oceanographic, and biological features of the environment and for monitoring net performance. Most of these sources involve relatively high frequency, directional, and brief repeated signals tuned to provide sufficient focus on and resolution of specific objects. Table A-1 shows important characteristics of the primary acoustic devices used on NOAA research vessels and NOAA-chartered vessels conducting AFSC fisheries surveys, followed by descriptions of some of the primary general categories of sources, including all those for which acoustic takes of marine mammals are calculated in the LOA application.

Table A-1 Output characteristics for predominant AFSC acoustic sources

Abbreviations: kHz = kilohertz; dB re 1 µPa at 1 m = decibels referenced at one micro Pascal at one meter; ms = millisecond; Hz = hertz

Acoustic system	Operating frequencies	Maximum source level (dB re 1 µPa at 1 m)	Single ping duration (ms) and repetition rate (Hz)	Orientation/ Directionality	Nominal beam width (degrees)
Simrad EK60 narrow beam echosounder	18, 38, 70, 120, 200 kHz	226.7	1 ms @ 1 Hz	Downward looking	11°
Simrad ME70 narrow beam echosounder	70 kHz	226.7	1 ms @ 1 Hz	Downward looking	11°
Simrad ES60 multibeam echosounder	38 and 120 kHz	226.6	1 ms @ 1 Hz	Downward looking	7°
Reson 7111 multibeam echosounder	38, 50, 100, 180, 300 kHz	230		Downward looking	150°

Single Frequency Sonars

The Dual Frequency Identification Sonar (DIDSON) operates on a high frequency of 12 MHz that allows for high resolution for up to 30 m even in dark turbid waters. This type of sonar is used for monitoring net shapes under different fishing conditions and for fish imaging and identification.

Bottom and pelagic trawls are typically outfitted with acoustic sensors that measure depths and widths of nets and transmit these data to the research vessel in real time. A headrope sensor is typically mounted on the head rope to measure the depth from the surface to the head rope and the height of the head rope above the bottom. A pair of spread sensors are mounted on the wings and/doors of the net to measure the width of the net opening. Acoustic signals can be broadcast to the research vessel to provide real time observations of net characteristics or transmitted via an electric cable to the vessel. The bottom trawl surveys use Marport head rope and spread sensors while the acoustic surveys use Simrad ITI door sensors and Simrad FS70 head rope sensor and third wire system. The Marport spread and head rope sensors and Simrad spread sensors operate at approximately 40 kHz, and the Simrad headrope sensor operates at 200 and 333 kHz.

Multibeam Echosounder and Sonar

Multibeam echosounders (Figure A-25) and sonars work by transmitting acoustic pulses into the water then measuring the time required for the pulses to reflect and return to the receiver and the angle of the reflected signal. The depth and position of the reflecting surface can be determined from this information, provided that the speed of sound in water can be accurately calculated for the entire signal path. The use of multiple acoustic 'beams' allows coverage of a greater area compared to single beam sonar. The sensor arrays for multibeam echosounders and sonars are usually mounted on the keel of the vessel and have the ability to look horizontally in the water column as well as straight down. Multibeam echosounders and sonars are used for mapping seafloor bathymetry, estimating fish biomass, characterizing fish schools, and studying fish behavior. The AFSC uses the Simrad ES60 operating at 38 and 120 kHz.

Side scan sonars (Figure A-25) are designed to produce imagery of the seafloor. Each side scan sonar consists of three parts: the towfish, the transmission cable, and the topside processing unit. The towfish is deployed near the seafloor and collects echo data for transmission to the topside processing unit which uses the information to develop imagery of the seabed. Images contain information regarding sediment type and general roughness, and tend to show an improved view of the seafloor over hull-mounted systems due to a lower angle of incidence with the seafloor. In addition to creating higher resolution imagery, side scan sonars are used to collect data on fluorescence of colored dissolved organic matter (CDOM), chlorophyll-a and turbidity.

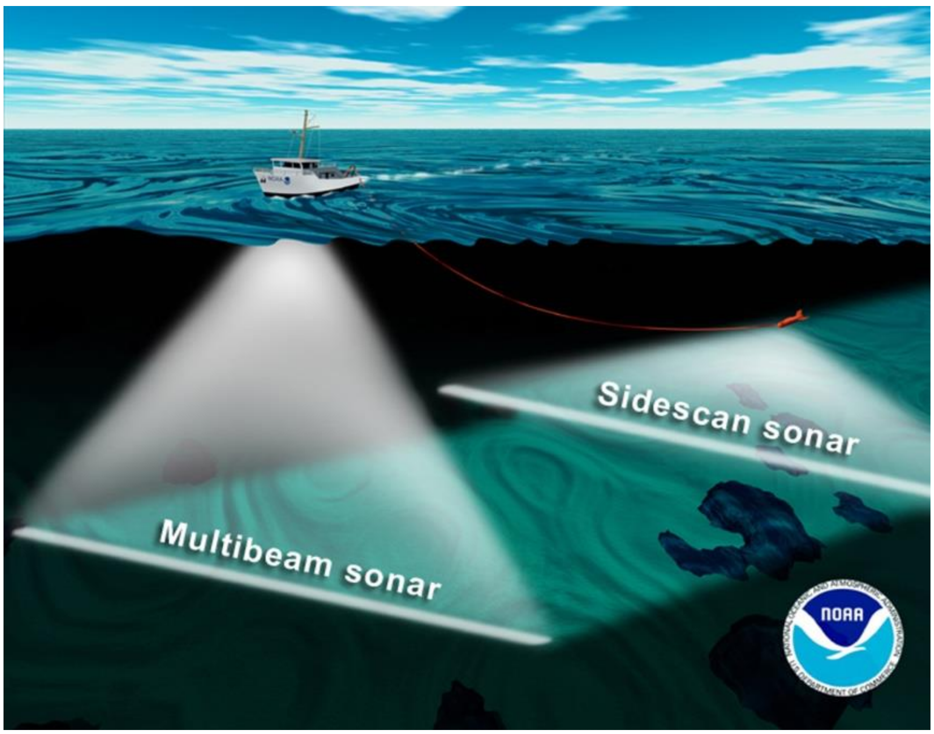


Figure A-25 Conceptual image of a multibeam echosounder and side scan sonar

Multi-Frequency Sensors

Similar to multibeam echosounders, multi-frequency split-beam sensors are deployed from NOAA survey vessels to acoustically map the distributions and estimate the abundances and biomasses of many types of fish; characterize their biotic and abiotic environments; investigate ecological linkages; and gather information about their schooling behavior, migration patterns, and avoidance reactions to the survey vessel. The use of multiple frequencies allows coverage of a broad range of marine acoustic survey activity, ranging from studies of small plankton to large fish schools in a variety of environments from shallow coastal waters to deep ocean basins. Simultaneous use of several discrete echosounder frequencies facilitates accurate estimates of the size of individual fish, and can also be used for species identification based on differences in frequency-dependent acoustic backscattering between species. The AFSC uses primarily the Simrad EK60, which is a split-beam echosounder with built-in calibration. It is specifically suited for permanent installation onboard a research vessel. The Simrad EK60s used in AFSC surveys operate in multiple frequencies simultaneously; 18, 38, 70, 120, and 200 kHz.

7. Underwater Cameras

The AFSC uses a diverse array of underwater camera housing designs in order to capture still and video footage of study areas. Some of these are attached to nets, and some have stand-alone housings that allow the camera to be deployed independently of survey fishing gear.

Underwater Cameras Attached to Fishing Gear

The Conservation Engineering surveys utilize a 20 x 9 x 4.5 inch camera and housing unit that is attached to the headrope of a research trawl. It is a complete integrated unit with internal LED light and battery. It is typically deployed on fishing gear by clipping it to the gear.

The FISHPAC survey utilizes a camera and sample collection device known as the Seabed Observation and Sampling System (SEABOSS, Figure A-26). The SEABOSS is designed to observe and collect data on sediment and physical seabed characteristics. The samples and video collected are used to groundtruth acoustic backscatter.

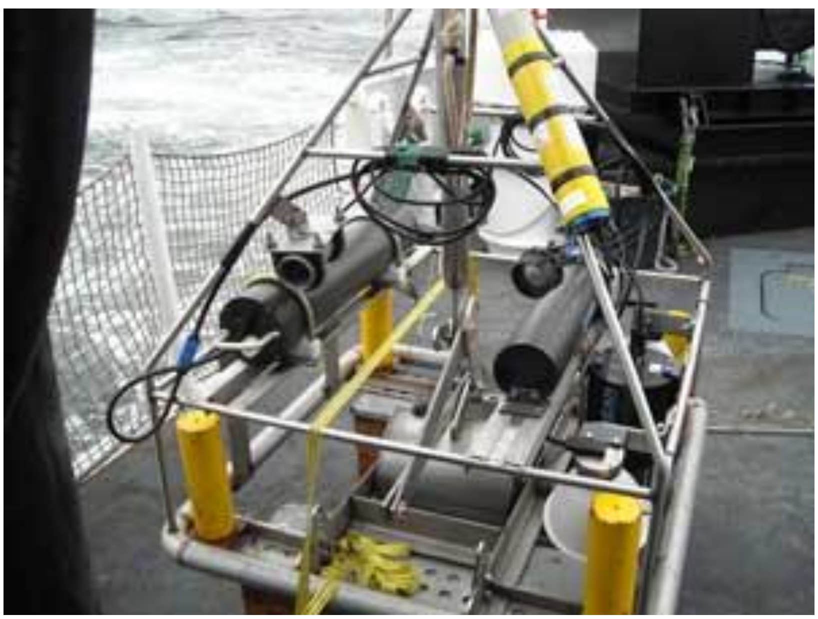


Figure A-26 SEABOSS

Underwater Cameras Deployed Independently of Fishing Gear

The Acoustic Assessment of Snakehead Bank survey used drop cameras housed in a 1 x 0.75 x 0.5 meter cage constructed from aluminum tubing. Two machine-vision cameras spaced approximately 3 cm apart in underwater housings are connected via ethernet cables to a computer also in an underwater housing within the cage.

The Rockfish Habitat Studies survey uses paired video cameras housed and mounted in a metal frame. They are deployed for approximately ~45 minutes at a depth of 45-100 m.

The Deep Sea Coral and Sponge Distribution surveys utilize a stereo camera sled with two cameras four strobe lights contained in an aluminum frame. It is designed to be drifted or towed along the seafloor at a distance of ~1 m off the seafloor. Other towed cameras include the Towed Auto-Compensating Optical System (TACOS, Figure A-27), which utilizes four to six underwater lights and a down-weight up to 25 m in front of the camera sled to stabilize sled motion (Figure A-28). The TACOS is used in the FISHPAC survey to groundtruth acoustic data.

Remotely Operated Vehicles (ROVs) and Autonomous Underwater Vehicles (AUVs) are either owned by AFSC or other NOAA entities and have the potential to be used in new techniques to survey fishes and quantify habitat.

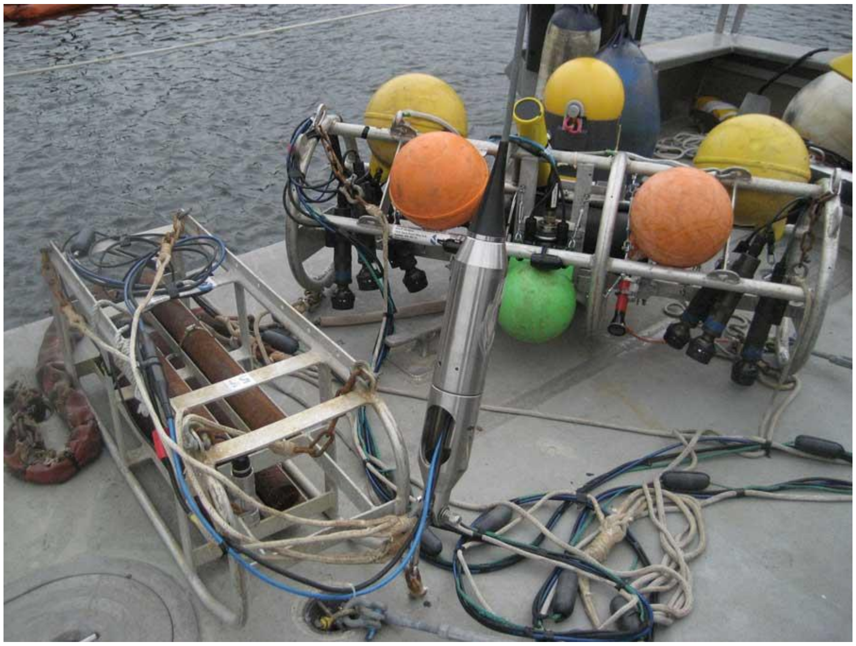


Figure A-27 TACOS video system with weighted sled

Figure A-28 TACOS video system during deployment

8. Vessels used for AFSC Survey Activities

The AFSC primarily employs one NOAA- owned and operated fisheries research vessel, the NOAA Ship *Oscar Dyson* (Figure A-29), and the Alaska Department of Fish and Game (ADFG) uses the R/V *Resolution* to conduct fisheries research on behalf of the AFSC. It also uses the NOAA Ship *Fairweather* (Figure A-30), as well as research vessels in the University National Oceanographic Laboratory (UNOLS) fleet. However, most of the vessels used for AFSC fisheries research are chartered fishing vessels. A wide range of commercial fishing vessels participate in such research, ranging from small open boats to modern trawlers and longliners measuring up to 57 m in length. The sizes of the vessels used, engine types, cruising speeds, etc. vary depending upon the location and requirements of the research for which the vessel is used. Although some vessels are chartered on a regular basis, the particular vessels used year to year depend on availability, research needs, and competition for contract services.

NOAA Ship *Oscar Dyson*

Figure A-29 NOAA Ship *Oscar Dyson*

The *Oscar Dyson* supports NOAA's mission to protect, restore and manage the use of living marine, coastal, and ocean resources through ecosystem-based management. Its primary objective is as a support platform to study and monitor Alaskan pollock and other fisheries, as well as oceanography in the Bering Sea and Gulf of Alaska. The ship also observes weather, sea state, and other environmental conditions, conducts habitat assessments, and surveys marine mammal and marine bird populations. Ship specifications are available at: http://www.moc.noaa.gov/od/

Figure A-30 **NOAA Ship *Fairweather***

The *Fairweather* is a hydrographic survey ship that was originally commissioned with NOAA in 1968. The ship was deactivated in 1989 but a critical backlog of surveys for nautical charts in Alaska was a motivating factor to reactivate the ship in 2004. The ship is equipped with the latest in hydrographic survey technology – multi-beam survey systems; high-speed, high-resolution side-scan sonar; position and orientation systems, hydrographic survey launches, and an on-board data-processing server. Increased mission space and deck machinery enable *Fairweather* to be tasked with anything from buoy operations to fisheries research cruises. Ship specifications are available at: http://www.moc.noaa.gov/fa/index.html

R/V *Resolution*

Source: http://www.adfg.alaska.gov/cfregion4/dynamic/research/view/NPRB:1107_Objectives

Figure A-31 R/V *Resolution*

One of many research vessels administered by ADFG, the 27.7m R/V *Resolution* (Figure A-30) was used in the ADFG Large-mesh Trawl Survey and the ADFG Small-mesh Shrimp and Forage Fish Survey.

9. References

Alaska Fisheries Science Center (AFSC). 2015a. Ichthyoplankton Cruise Database gear dictionary. Available online at: http://access.afsc.noaa.gov/icc/gearframe.php

AFSC. 2015b. MESA archives: effects of bottom trawling on soft-bottom sea whip and other habitat in the central Gulf of Alaska. Available online at: http://www.afsc.noaa.gov/ABL/MESA/archives/effects%20of%20trawl%20on%20seawhips.htm

California Department of Fish and Wildlife. 2015. Delta Smelt Populations Plummet 2nd Year in a Row. Available online at: http://www.capradio.org/articles/2016/03/07/delta-smelt-populations-plummet-2nd-year-in-a-row/

Dougherty, A., C. Harpold, and J. Clark. 2010. Ecosystems and Fisheries-Oceanography Coordinated Investigations (EcoFOCI) field manual. AFSC Processed Rep. 2010-02, 213 p. Alaska Fish. Sci. Cent., NOAA, Natl. Mar. Fish. Serv., 7600 Sand Point Way NE, Seattle WA 98115.

Delta Oceanographics. 2015. Available online at: http://www.deltaoceanographics.com/sub.html

Food and Agriculture Organization of the United Nations (FAO). 2015a. Fishing gear types: cast nets. Available online at: http://www.fao.org/fishery/geartype/217/en

FAO. 2015b. Guidelines for sampling fish in inland waters: sampling with traps. Available online at: http://www.fao.org/docrep/003/aa044e/aa044e05.htm

Hovgård, H. and Lassen, H. 2008. Manual on estimation of selectivity for gillnet and longline gears in abundance surveys. FAO Fisheries Technical Paper. No. 397. Rome, FAO. 84 pp. Available online at: http://www.fao.org/docrep/005/X7788E/X7788E00.HTM

Maryland Department of Natural Resources. 2016. 2016 Blue Crab Winter Dredge Survey. Available online at: http://dnr2.maryland.gov/fisheries/Pages/blue-crab/dredge.aspx.

Net Systems Inc. 2016. Available online at: http://www.net-sys.com/96-2/

NOAA Fisheries. 2014. Fishing Gear and Risks to Protected Species. Last updated: January 30, 2014. Available online at: http://www.nmfs.noaa.gov/pr/interactions/gear/

Sea Fish Industry Authority (Seafish). 2005. Basic Fishing Methods. Manchester Street, Hull, UK, APRIL 2005.

Stauffer, G. (Compiler). 2004. NOAA protocols for groundfish bottom trawl surveys of the nation's fishery resources. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-F/SPO-65, 205 p.

University of Alaska Fairbanks (SFOS) Coastal Marine Institute. Available online at: https://www.sfos.uaf.edu/research/seaicebiota/CMI_crab/images.html

WHOI (2011). Woods Hole Oceanographic Institution, Ships and Technology. Available online at: http://www.whoi.edu/ships_technology/

Walden, J.B. 1996. The New England gillnet effort study. Northeast Fisheries Science Center. Reference Document 96-10; 38p. Available from: National Marine Fisheries Service, 166 Water St., Woods Hole, MA 02543-1026.